ORIGINAL

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Tele-Communications, Inc.,	)	CS Docket No. 98-178
	)	
Transferor,	)	
	)	
AT&T Corp.,	)	
	)	
Transferee.	)	

To: The Cable Services Bureau

Comments of the
National Association of Broadcasters

The National Association of Broadcasters ("NAB")[1] submits these comments on the proposed merger of AT&T and Tele-Communications, Inc. ("TCI"), the Nation's second largest cable operator. NAB takes no position on whether the Commission should allow the merger of these two companies. Instead, NAB asks that the Commission ensure that the broadband digital facilities that will be constructed by the merged company – which are the primary benefit to the public cited by AT&T and TCI – will not be used to weaken competition in the video marketplace through the exercise of gatekeeper control over competitors' access to consumers. Specifically, NAB asks the Commission to condition its approval of the AT&T-TCI merger on those companies' assurances that all of their upgraded systems will be fully capable of delivering over-the-air

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[1] NAB is a non-profit incorporated association of radio and television stations and broadcasting networks. NAB serves and represents the American broadcasting industry.

digital television signals to consumers' digital television sets without degradation and that the upgraded cable systems will carry the digital signals of all television stations in their markets as those digital signals come on the air.[2]

As the parties stated in their applications seeking Commission approval of the merger, "the Merger will foster new facilities-based competition in the provision of local telephone service and result in the provision of new and enhanced services to the public without reducing competition in any service or market."[3] They expanded on this point in testimony at the Commission's *en banc* hearing on October 22, 1998. TCI's President, Mr. Hindery, told the Commission that the merger would enable him "to offer a seamless world of video, data, and telephony – all digital telephony – to every one of those homes [in TCI's service areas] just as quickly as I can."[4] Mr. Hindery also

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2 As described more fully in NAB's Comments in CS Docket No. 98-120 (filed Oct.13, 1998), the Commission is obligated under Section 614 of the Communications Act, 47 U.S.C. § 534, to adopt rules requiring carriage of local digital television signals by all cable systems. The request by AT&T and TCI for approval of their merger based on commitments to a very rapid reconstruction of TCI's cable systems provides a separate basis for the Commission to require carriage of digital signals on those systems in order to ensure that those systems will be designed to accommodate the transmission of digital television signals to consumers and, as described below, to forestall misuse of the merged companies' gatekeeper facilities.

3 Application of Tele-Communications, Inc. and AT&T Corp. for Authority Pursuant to Section 214 of the Communications Act of 1934, as amended, for Transfer of Control of Authorizations to Provide International Resold Communications Services, filed Sept. 14, 1998, at 3 [hereinafter *TCI-AT&T Application*].

4 Quotations from testimony at the October 22, 1998 *en banc* presentation were transcribed by NAB from the RealAudio archive at http://www.fcc.gov/realaudio/archive/eb102298.ram [hereinafter *En Banc Testimony*].

told the Commission that, while TCI has already committed itself to digital upgrades of its cable systems, the merger with AT&T "will significantly accelerate the upgrade of our networks."[5]

Thus, the central element of the public interest that the merging parties claim supports their application is the increased speed of the transition of TCI's cable systems from analog to digital that AT&T's investment will make possible. A study by Strategic Policy Research attached to NAB's recent comments in the digital must carry proceeding[6] concluded that the cable industry will expand capacity "to win the race with telcos and others for the high-speed Internet access business," and "in order to offer voice telephony." *SPR Report* at 34. The plans announced by AT&T and TCI are fully consistent with those predictions. The *SPR Report* goes on to conclude that:

> "This capacity expansion should easily accommodate full digital television must-carry and the resulting 'burden,' would be less in relative terms, that the 'burden' created by the existing must-carry rules. Moreover, if the FCC promptly mandates digital must-carry (as it should), given the cable industry's already-announced plans to upgrade their systems, cable operators will incur little incremental cost in making certain adequate capacity is available when needed."[7]

Thus, the restructuring of all TCI cable systems to allow for Internet access and digital telephony will at the same time provide dramatically increased capacity for distributing video signals to consumers. Not only will TCI systems have more bandwidth capacity to use, the

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5 *Id.*

6 Strategic Policy Research, *Cable System Capacity: Implications for Digital Television Must-Carry*, Attachment D to Comments of the National Association of Broadcasters, CS Docket No. 98-120 (filed Oct. 13, 1998)[hereinafter *SPR Report*]. A copy of the *SPR Report* is attached to these Comments for the Commission's convenience.

7 *SPR Report* at 34.

conversion to digital will also make it possible to use that bandwidth more efficiently. As the *SPR Report* explains, digital cable systems can compress multiple NTSC signals or two digital television signals into one six MHz "channel." *SPR Report* at 23-26. TCI and AT&T's announced plans, therefore, remove any argument that carriage of local digital television signals will burden their cable systems or require removal of popular cable programming.

If the rapid build-out of digital cable capacity is in the public interest, as TCI and AT&T claim, it is certainly equally in the public interest that this new capacity not be used to cement existing monopolies. The merging companies indeed claim that their merger "should stimulate MVPD competition." *TCI-AT&T Application* at 34. They point out that, in addition to the competition they face from existing local over-the-air television stations, "the over-the-air broadcast stations will launch digital service beginning in a few months, which will increase still further their competitive presence in the MVPD marketplace." *Id.* at 34-35 n.67. It would be a shocking misuse of their monopoly status if the merged AT&T-TCI cable systems were to deny carriage to new digital television signals, and thus impair the competitive impact of those signals, while at the same time urging the Commission to rely on those same signals as competitive safeguards against monopolistic abuses.

It was indeed this very problem that lead Congress to adopt must carry rules in 1992. In passing the Cable Act, Congress found that, because local television stations compete with cable systems, "there is an economic incentive for cable systems to terminate the retransmission of the broadcast signal, refuse to carry new signals, or reposition a broadcast signal to a disadvantageous

channel position."[8] And while cable systems' ability to disadvantage local analog television stations has been restrained by the must carry provisions of the Cable Act and the Commission's implementing rules, these anticompetitive tendencies remain evident. Video program providers that are not affiliated with the major cable system operators are complaining that new digital channel capacity is being reserved for new channels from existing program providers, most of which are owned by cable operators.[9]

Even more ominously, at the October 22 *en banc* hearing, Chairman Kennard asked Mr. Hindery about reports that TCI systems offering Internet access are limiting customers to ten minutes of streaming video, apparently in an effort to suppress competition from Internet video sources to TCI's video programming. Mr. Hindery admitted that the limitation had been imposed by TCI so that "we were the determiner of how streaming video worked in our world." *En Banc Testimony*. In other words, in providing Internet service, TCI reserves for itself the right to limit access to potentially competitive programming providers. This is all too reminiscent of a statement of a cable operator quoted in the House Report on the Cable Act explaining why a cable system would not carry local stations: "Why have people trained to watch UHF?"[10]

To ensure that TCI and AT&T will not use the digital capacity that they will construct in a manner that will frustrate competition, the Commission should require, as a condition of its

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[8] Cable Television Consumer Protection and Competition Act of 1992, Pub. L. No. 102-385, § 2(a)(15).

[9] *See* "Cable Giants Flex Multiplexing Muscle," http://www.msnbc.com/news/208997.asp (Oct. 2, 1998).

[10] H. REP. NO. 628, 102d Cong., 2d Sess. 52 (1992), *quoting* Comments of the National Association of Broadcasters, MM Docket No. 88-138 (filed July 8, 1988), at 15-18.

approval of the merger, that they offer to carry all local digital television signals to consumers on all upgraded cable systems.[11] Particularly since television stations will begin to offer digital signals over several years – during the same period in which the cable systems will be rebuilt – this will not impose a sudden burden on AT&T and TCI, but it will provide the Commission and the public with some confidence that the merger of these two enormous companies will not result in further deterioration of competition in the video marketplace, or delays in free over-the-air television's transition to digital technology.

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[11] Notably, in his testimony in the October 22 *en banc* hearing, AT&T's Chairman pointed out the continuing need in markets where TCI does not operate cable systems for the Commission to ensure that local telephone companies in those areas do not use their gatekeeper facilities to damage or prevent competition. *En Banc Testimony.* In making the present request concerning operation of the merged TCI-AT&T cable systems, NAB seeks no more.

For the foregoing reasons, the Commission should require AT&T and TCI to carry all digital signals of local television stations in the markets in which they operate upgraded cable television systems.

Respectfully submitted,

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Cable System Capacity: Implications for Digital Television Must-Carry

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Executive Summary

This paper examines the issue of whether cable television systems are likely to have the capacity to carry the full digital signal of local television broadcasters during the transition to terrestrial digital television which has been mandated by Congress. In crafting a digital must-carry rule, it is important for the Commission to keep in mind that, in the absence of such a rule, the cable industry has little incentive to make it a smooth transition. The paper identifies three market failures which make it unlikely that reliance on "market forces and private agreements" (in the Commission's words) will be effective in achieving the statutory goals.

The paper discusses how the cable industry's rhetoric during litigation over the existing must-carry rules proved baseless and unpersuasive to the Supreme Court. Notwithstanding the repeated claims of cable operators and cable programmers, the sky did not, in fact, fall. Must-carry stations occupy a relatively small percentage of the capacity of most cable systems today, and cable program services (*e.g.*, C-SPAN and BET) continue to grow both in number of subscribers and in number of cable systems on which they are carried.

Cable channel capacity is constantly being expanded as system operators rebuild or modify their systems to incorporate the latest technology (*e.g.*, fiber optics, new modulation and compression techniques). In looking at the cable industry of today, we find that (1) channel capacity has been expanding significantly over time; (2) existing channel capacity is quite substantial, particularly in large markets where the Commission has required digital television service to be rolled out first; (3) significant unutilized channel capacity currently exists; and (4) the capacity occupied by local broadcast stations (those eligible for must-carry) is well below the 33 percent statutory ceiling. These data provide *conservative* measures on a variety of counts (*viz.*, they are historical data, capacity is being expanded, technical advances are constantly increasing the carrying capacity of given bandwidth, *etc.*). They suggest that there are no *technical* constraints limiting the carriage of digital broadcast signals as the digital transition commences. Existing unused capacity in most cases could easily support carriage of new digital broadcast signals when the initial stations begin operation later this year.

In looking ahead, we find that cable systems will be expanding capacity substantially over the course of the next five years during which the transition to digital television is expected to take place. This expanded capacity will come about as cable systems continue to expand the capacity of their analog plant and deploy their own digital capability. Given the technological opportunities and potential new service opportunities that the cable industry has already embraced, we determine that a number between 200 and 500 mixed digital and analog channels is readily within the reach of most operators within the next few years and is a reasonable number for the Commission to use in estimating the "burden" of full digital television must-carry.

The paper discusses how system upgrades to accommodate high-speed Internet access and voice telephony (as well as the potential for video telephony) provide cable operators with a window to deploy more than enough additional capacity to carry the new digital broadcast signals and add new cable services. Viewed from this perspective, the incremental costs to cable operators of meeting a full digital television must-carry requirement will be minimal.

The paper emphasizes that the Commission must act now so that broadcasters and cable operators can plan for the digital transition.

I. Introduction

The Commission's *Notice* solicits comment "on *whether* to amend the cable television broadcast signal carriage rules . . . to accommodate the carriage of digital broadcast television signals."[1] The Commission is directed by statute to establish requirements "necessary to ensure carriage" of digital television signals.[2] The Commission notes that it is directed (in the legislative history) to "conduct a proceeding to make any changes in the signal carriage requirements of cable systems needed to ensure that cable systems *will carry* [digital] television signals."[3] We respectfully suggest that, based on the analysis prepared by Jenner & Block for the NAB in this proceeding, the relevant policy question is not whether to amend, but *how* specifically to amend the cable carriage rules to meet statutory objectives.

The Commission notes that, in addition to the goal of "retention of the strength and competitiveness of broadcast television" (the goal whose achievement primarily underlies existing carriage requirements), Congress also seeks "the successful introduction of digital broadcast television and the subsequent recovery of the vacated broadcast spectrum."[4] Thus, given the critical role digital carriage requirements will play in the successful realization of this latter goal, an important *additional* public policy rationale in favor of digital carriage requirements has been enunciated for consideration in establishing such requirements.

In considering how to amend its existing must-carry rules to facilitate the transition to digital broadcast television, the Commission must bear in mind the economic reality that, in the absence of such rules, the cable industry has little reason to make it a smooth transition. In particular, cable system owners realize none of the external benefits that cable carriage produces for the 35 percent of television households that do not subscribe to cable. Moreover, as a local monopolist, each cable system has a substantial advantage in bargaining for carriage rights which renders a negotiated outcome consistent with statutory objectives all but illusory.

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1 *In the Matter of Carriage of the Transmission of Digital Television Stations*, CS Docket No. 98-120 (July 10, 1998), ¶ 2.7

2 *Ibid.*

3 *Ibid.* Reference in footnote 1.

4 *Ibid.*, ¶ 1.

While the Commission's *Notice* suggests a number of possible scenarios for new digital television must-carry rules, our analysis supports a full must-carry requirement, by which we mean a rule that requires every cable system to provide enough capacity to carry the full digital signal of every local broadcaster.[5]

[5] We recognize that the statute exempts from the carriage requirement any ancillary service that is offered on a subscription basis. However, as a practical matter, cable operators may well agree to carry such a service rather than incur the costs of stripping it out of the broadcast signal or otherwise blocking it. Our analysis shows that cable systems can be expected to have *the capacity* to carry the entire digital signal.

II. Focus of the Report

In its *Notice*, the Commission specifically states that "[d]etermining a cable operator's capacity when digital content is involved and therefore how many commercial television station signals must be carried" is an issue in this proceeding.[6] The Commission raises a number of questions regarding the appropriate definition of cable system capacity and how technical advances can be expected to affect system carrying capacities as the future unfolds. This report focuses on these questions and issues, and attempts to meet the Commission's need for good technical information.

The Commission seeks quantified estimates and forecasts of usable channel capacity as well as methods for forecasting usable channel capacity and potential broadcast needs, nationally, during the transition to digital broadcasting. We have assembled a variety of evidence that should provide the Commission with a good data base on which to base carriage policy.

The report is organized in the following manner: We start by briefly discussing several important economic considerations related to cable's role in the transition to digital television. We then examine the analogous set of issues as they were posed and resolved in the judicial proceedings that led to the Supreme Court's rejection of a constitutional challenge to the existing must-carry requirements. Notwithstanding complaints and dire predictions by cable system operators and cable programmers, the Supreme Court concluded that "the actual effects are modest" and that "[s]ignificant evidence indicates that the vast majority of cable operators have not been affected in a significant manner by must-carry."[7]

The Commission now asks "how the court's reasoning and conclusions would apply in the context of this proceeding."[8] We seek directly to provide an answer to this question. First, we provide a detailed picture of the actual capacity of existing cable systems utilizing one of the leading data sources on this topic. This snapshot picture of the (near) current state of play supplies a reality

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6 *Op cit.*, ¶ 58.

7 *Turning Broadcasting System v. FCC ("Turner")*, 117 S. Ct. 1174 (1997), at 1198. We note that we supplied the evidence upon which the Court primarily relied in reaching this conclusion. *See* Expert Declaration of Harry M. Shooshan in *Turner Broadcasting System, Inc., et al., Plaintiffs, v. Federal Communications Commission, et al., Defendants*, U.S. District Court for the District of Columbia, Docket No. C.A. No. 92-2247 (and related cases C.A. Nos. 92-2292, 92-2494, 92-2495, 92-2558) (TPJ), Expert's Report filed April 21, 1995; Expert Declaration filed May 25, 1995 ("Expert Declaration of Harry Shooshan").

8 *In the Matter of Carriage of the Transmission of Digital Television Stations*, CS Docket No. 98-120 (July 10, 1998), ¶ 2.7, *Op cit.*, ¶ 15.

check/factual grounding both on which to formulate policy and from which to extrapolate future trends. Cable plant is undergoing significant modification and expansion as system operators seek to capitalize on new business opportunities afforded by technology and evolving consumer demands.

We then go on to describe these changes and assess their implications for the system capacity issues posed in this proceeding. Our view of the future is analogous to a (rapidly) moving picture with cable capacity expanding based on new enterprise opportunities and changing customer needs such that at any given time the "burden" of digital TV must-carry can be expected to be *de minimus*. Any additional "burden" on cable operators will be temporary since, at the end of the transition period, broadcasters will have a single signal subject to the must-carry requirement. Moreover, since full digital TV must-carry can be expected to accelerate the transition (and, thereby, the return of the analog spectrum), imposing such a requirement will actually mitigate the "burden" on cable systems.

Based primarily on cable's announced plans to expand system capacity and on available technology, we conclude that capacity in the range of 200 to 500 channels is easily attainable by most systems over the next few years. What is needed is clear direction from the FCC to implement Congressional intent that there be full digital television must-carry.

III. Economic Considerations: Why Market Forces and Private Agreements Are Insufficient

We share the Commission's stated belief that "participation by the cable industry during the transition period is likely to be essential to the successful introduction of digital broadcast television and the rapid return of the analog spectrum to the Commission."[9] The Commission desires "an efficient and orderly structure that implements the law in a manner that, to the extent possible, permits market forces and private agreements to resolve issues and also respects the First Amendment rights of all participants as established by court precedent."[10]

While we certainly believe "market forces and private agreements" have a role to play, we think it is important for the Commission to recognize that there are three significant *market failures* that, on the one hand, undermine the ability of market forces and voluntary exchange to produce economically efficient results and, on the other, supply a compelling microeconomic rationale for government intervention to secure public interest objectives. The instant setting is one where, left to its own devices, a "spontaneous order" is not likely to prove either efficient or effective in realizing specified policy goals.

First, as the Commission itself has repeatedly been compelled by overwhelming evidence to conclude,[11] local cable television systems are multichannel video program distribution (MVPD) monopolists in their local markets. Cable's principal competitor, DBS, has achieved only minimal market penetration, does not now supply effective competition and is not likely to provide effective competition to incumbent cable monopolists during the digital broadcast transition.[12] Indeed, the market success of DBS has occurred primarily in areas unserved by cable.[13] Local cable MVPD

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9 *Ibid.*, ¶ 14.

10 *Ibid.*, ¶ 1.

11 *See In the Matter of Annual Assessment of The Status of Competition in the Market for the Delivery of Video Programming* ("Annual Reports"), various numbers.

12 Cable industry sales propaganda disparages the competitiveness of DBS offerings, calling attention to a variety of disabilities and shortcomings from a potential consumer's perspective.

13 National market share statistics thus overstate even the minimal level of competition that exists. In its 1997 Annual Report, the FCC reports that satellite subscribership ranges from 23.6 percent in Montana to 2.3 percent in New Jersey.

monopolists also exercise significant *monopsony* power.[14] Many video program channels seek access to local audiences, but there is generally only a single, economically dominant MVPD in each local market and, as a result, there is a significant imbalance in bargaining power. Where there is such a great imbalance of market power in cable's favor, negotiations unconditioned by assignment of carriage rights can hardly be relied upon to produce efficacious results, particularly where such a clear public interest stake in carriage of digital broadcast signals has been enunciated by Congress.

Second, in evaluating carriage decisions a cable system operator cannot be reasonably expected to take cognizance of the *external benefits* cable carriage of broadcast signals produces for *non-cable* subscribers. By increasing the potential audience for broadcast signals afforded carriage, cable carriage increases a station's advertising revenues. Such increases in revenue-producing potential, in turn, translate into increased investments in programming and, in consequence, a greater quantity and higher quality of over-the-air broadcast programming. The benefits of better broadcast programming redound to both cable subscribers *and* non-subscribers. Since cable system operators cannot appropriate a reward for helping to produce these external benefits, there will be a systematic tendency for them to undervalue the benefits of broadcast signal carriage relative to their actual level (*i.e.*, including the un-appropriable external benefits) and, hence, a tendency toward less than economically optimal broadcast signal carriage.[15]

Third, in addition to these external benefits to non-cable subscribers, there are also external benefits of carriage flowing from the successful introduction of digital broadcast television and the timely return of vacated broadcast spectrum. A variety of potential synergies in production and consumption have been identified by Congress and deemed worthy of pursuit through prudently crafted public policy. Again, cable system operators cannot be reasonably expected to assay these

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[14] The Commission's economic analysis of cable monopsony power is deeply flawed (*see* Annual Reports, *op cit.*). Focusing on concentration of multiple system ownership on a national basis, the Commission has failed to grasp that relevant markets are local (a finding it does make in analyzing cable's market power as a MVPD seller) and that cable's local "gatekeeper" status affords significant bargaining power. As Professors David Waterman and Andrew A. Weiss note (p. 154) in their scholarly treatise on *Vertical Integration in Cable Television* (The AEI Press, The MIT Press: 1997), "The FCC is simply wrong to apply the HHI standards or other benchmarks of firm concentration to the MSO case. . . . The rate at which an MSO can accumulate monopsony power has nothing to do with the standard interpretation of the HHI, because *virtually none of the cable system buyers compete with another for programs*" (emphasis added).

[15] Congress and the courts have also recognized the merit of promoting widespread dissemination of information from a multiplicity of sources. Broadcasting is thus afforded status as a "merit good" in economic terms. The merit benefits of broadcasting cannot be economically appropriated by cable system operators and they will thus ignore them in evaluating carriage alternatives.

external benefits (since they cannot be easily or feasibly economically appropriated) and they will, therefore, again systematically undervalue the benefits of digital signal carriage relative to the norm of economic efficiency (*viz.*, efficient internalization of external effects of private production and consumption decisions).[16]

Beneficial economic consequences of digital signal carriage are, of course, only one side of the story. In economic terms, the existence of market failures does not necessarily imply that government intervention will actually improve economic efficiency. Whether intervention proves economic-welfare-enhancing turns on the specific characteristics of the intervention.

Important in this regard are answers to factual questions about the capacity of cable systems and how capacity can be expected to evolve over time with changes in technology and the business focus of cable system operators, as well as the technical demands that are likely to be placed upon them as digital broadcast operations are brought on line. This paper supplies answers to those questions which suggest that full digital TV must-carry will not impose an undue burden on cable operators or foreclose carriage opportunities for cable program services. However, especially since monopoly system operators control how much capacity is available at any given time, we believe it is imperative that the Commission move quickly to adopt digital TV must-carry rules so that cable operators can plan accordingly.

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[16] There are a variety of "chicken-and-egg" problems that need to be overcome for successful introduction of digital broadcast television. For example, set penetration will depend on the attractiveness and availability of the program offerings, which depends on cable carriage decisions, which depend— in the absence of government intervention— on the consumer surplus cable system operators can expect to extract for providing access to digital broadcasts, which depends on set penetration, *etc.*

IV. If Past Is Prologue

As the debate is joined over digital must-carry, there is an unavoidable sense of *deja vu* in the arguments being marshaled by the cable industry (system owners and certain cable program services) in opposition to digital must-carry rules. Requiring cable operators to carry the broadcasters' new digital signals will allegedly swamp system capacity and force operators to drop certain marginal cable program services (*e.g.*, C-SPAN and BET).[17] This was, of course, precisely what the cable industry argued (unpersuasively, as it turned out) in its challenge to the must-carry provisions of the 1992 Cable Act.

It may be instructive, therefore, to recall how the facts and actual outcomes diverged from cable's rhetoric in the period between 1992 and 1995 (the relevant period for purposes of the Supreme Court's consideration). Then, as now, cable operators argued that the imposition of a must-carry requirement would place an undue burden on them. In fact, according to a 1995 survey of cable systems conducted by the FCC in the context of must-carry litigation, it was determined that, on average, must-carry stations occupied only 12 percent of channel capacity. Those stations added as a result of the 1992 Act took up an average of only 2 percent of system capacity.[18] For Time Warner, the second largest cable MSO, the average number of channels occupied by must-carry stations was only 4.2 or roughly 9 percent of system capacity on average.[19]

In an analysis we performed in 1995,[20] we noted that even these low percentages needed to be considered in the context of the rapid expansion of cable system capacity that had been occurring and has, of course, continued to occur. Indeed, we noted that the cable industry had added "enough channels *in less than two months* to carry all of the must carry requirements since the passage of the Act" (emphasis added).[21] At that time, the total universe of channels was increasing at a rate of over

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17 Strategic selection of "poster-child" examples of alleged harms is, of course, to be expected.

18 Another 10 percent of capacity was taken up by stations carried voluntarily under retransmission consent. Expert Declaration of Harry M. Shooshan,, ¶ 11.

19 *Ibid.*,, Exhibit A, ¶ 9.

20 *Ibid.*, ¶ 29.

21 *Ibid.*

3,000 a month and that rate was accelerating. We estimated that must-carry stations were using only about 6.7 percent of the capacity added since the 1992 Act was passed.[22]

While full digital TV must-carry will result in a significantly larger number of carried stations (during the transition period) than was the case following passage of the 1992 Cable Act, the "burden" created by such a requirement must be viewed in the context of the steady (and, in light of technical advances, likely accelerating) growth in the capacity of cable systems. This past experience is instructive (and probative) because it demonstrates that cable operators' previous claims about the impact of must-carry were grossly exaggerated and misleading. Notwithstanding the cable industry's repeated claims, the sky did not, in fact, fall.

Past experience also provides a ground for evaluating the claims by cable programmers that they are likely to be dropped by cable systems as a result of digital TV must-carry. Precisely these same arguments were made in the court challenge to the must-carry requirements of the 1992 Cable Act. C-SPAN, in particular, claimed that it had suffered significant harm from being dropped by cable systems which needed capacity to add additional must-carry stations.

The facts adduced in the course of the litigation showed otherwise. In fact, based on evidence submitted by the cable industry's own expert, nearly 95 percent of cable systems did not have to drop *any* programming service.[23] Based on analysis performed by SPR, cable operators carried *more than 99 percent* of the programming they were carrying *before* passage of the 1992 Act.[24] Moreover, during the period between 1992 and 1995, cable networks actually realized substantial increases in net subscribership.[25] The allegations made by the cable programmers involved less than 1 percent of cable systems.[26]

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22 *Ibid.*

23 *Ibid.*, ¶ 15.

24 *Ibid.*, ¶ 5.

25 As we note in Section VI, cable operators, on average, are projected to add more than enough capacity to accommodate digital TV must-carry stations and add new cable services without having to displace existing services.

26 It was by no means clear that, even in the relatively few cases where there appeared to be a problem, cable operators were not behaving strategically; that is, citing must-carry as the reason for withholding or removing channels (*i.e.*, terming systems as "channel-locked") which they intended to use for other purposes (*e.g.*, pay-per-view). *See* Expert Declaration of Harry Shooshan.

Overall, notwithstanding claims made by cable programmers, cable networks prospered by virtually any measure during the 1992-1995 period. Total subscribers to all cable networks grew by 9 percent, license fee revenues grew by 47 percent and advertising revenues increased by 52 percent.[27]

Individual cable networks also experienced substantial growth during this period. Black Entertainment Television (BET) was carried on 1,951 cable systems in 1992 and on 2,471 systems in 1995. BET subscribership grew in the same period from 29.7 million to 36.4 million. C-SPAN was available to 53.6 million cable subscribers in 1992 (4,253 cable systems) and to 62.4 million subscribers in 1995 (5,200 cable systems). C-SPAN 2 experienced even more substantial growth in subscribers, going from 24.3 million (933 cable systems) to 37 million (1,357 cable systems).[28]

Again, we point to the past record because it demonstrates that the cable industry, notwithstanding its claim of incapacity and suffering, was unable to substantiate claims of *actual* harm to the satisfaction of the Court. Thus, it behooves the Commission to take with a grain (pound?) of salt the industry's predictions of *potential* harm, especially in the face of the excess system carrying capacity that exists today and the substantial additional capacity that cable can reasonably be expected to add during the digital TV transition (subjects to which we now turn).

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[27] *See* Expert Declaration of Harry Shooshan.

[28] *Ibid.*, Exhibit A, p. 721. We note that current system carriage numbers for these three cable networks are: BET — 2,616; C-SPAN — 6,114; C-SPAN 2 — 1,688. Source: *Cablevision Magazine* on-line (10/5/98).

V. Cable System Capacity: Recent Trends and Current Status

A core issue for establishing an economically efficient digital must-carry regime is the ability of cable systems to satisfy new signal carriage requirements (*i.e.*, additional signals). To get an empirical handle on this issue, we begin with an analysis of cable systems' current channel-carrying capacity. Channel capacity is, of course, constantly being expanded as system operators rebuild and modify their systems to embody the latest and greatest technology. Current capacity is thus only a starting point and a quite conservative measure of channel carrying capability.

Our benchmark analysis is based on a leading database on U.S. cable system operations.[29] In our view, this database is one of the most complete and reliable available, and provides a sound basis on which to proceed.

A. National Trends

These data and analogous data collected by the same firm in previous years provide a picture of how cable system capacity has been growing over time. Figure 1 shows the number of cable systems within particular ranges of channel capacity for the years 1985, 1993, and 1997 (the most recent published data available). Figure 2 shows the percentage of cable subscribers in those three years served by systems in these same capacity ranges.

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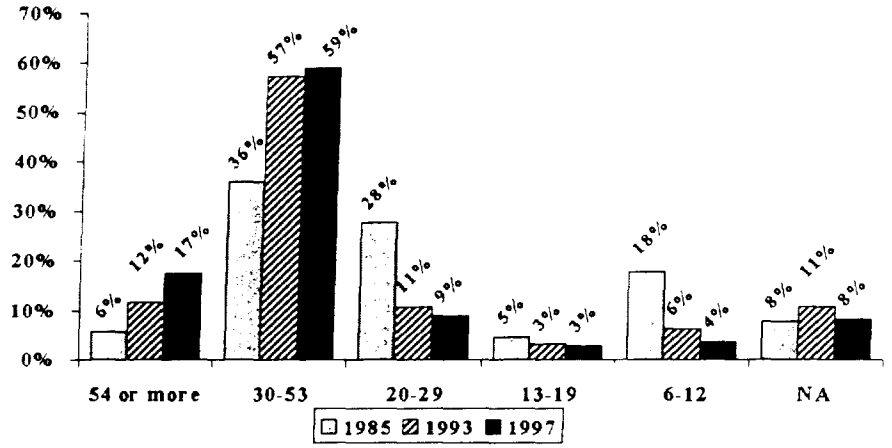
[29] Cable system data were obtained from Warren Publishing, Washington, D.C. publishers of *TV and Cable Factbook*, an annual compilation of the television and cable industries. The data included in this database are obtained through surveying all cable systems. In the database supplied to NAB, 26 percent of tier subscriber data are from 1997 or later, and 51 percent are from 1995 or later. This database appears to be the most thorough and dependable publicly available source of such information, although because it is somewhat dated, if provides conservative measures of the current state of play.

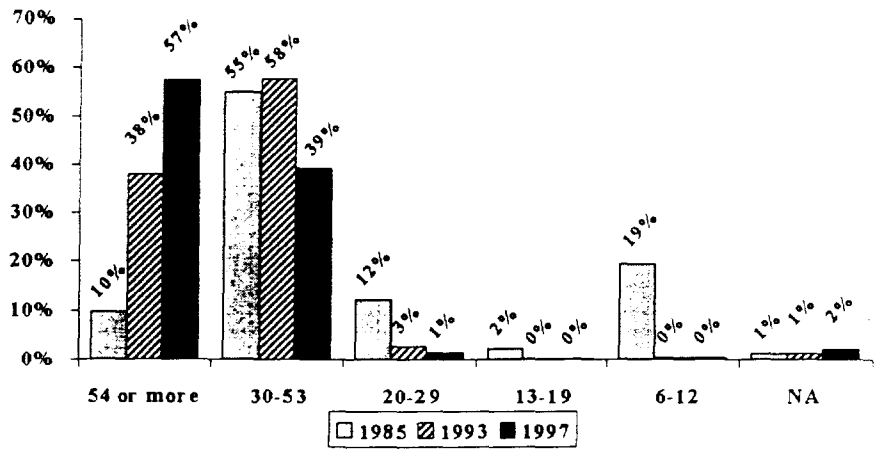
Figure 1
Percent of Systems by System Channel Capacity:1985, 1993, 1997



Source: Warren Publishing, Inc., *Television & Cable Factbook, Cable & Service Volume No. 53, 1985, p. 1385, Services Volume No. 65, 1997, p. I-81, Services Volume No. 66, 1998, p. F-2*

Prepared by Research & Planning Department, National Association of Broadcasters

Figure 2
Percent of Subscribers by System Channel Capacity:1985, 1993, 1997



Source: Warren Publishing, Inc., *Television & Cable Factbook, Cable & Service Volume No. 53, 1985, p. 1385, Services Volume No. 65, 1997, p. I-81, Services Volume No. 66, 1998, p. F-2*

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Figure 1 shows a steady increase in the number of systems with higher capacity during this period. By 1997 over three-quarters (76 percent) of all systems had 30 or more channels as compared to less than half (46 percent) in 1985. The increase is even more dramatic with regard to systems serving larger numbers of subscribers. Figure 2 shows that over 96 percent of all subscribers in 1997 were being served by systems with 30 or more channels. Interestingly, the number of subscribers served by systems with capacity of between 30 and 53 channels actually decreased between 1993 and 1997. Obviously, virtually all of these subscribers are now being served by systems with 54 or more cable channels.

B. Classification of Cable Systems

To respond to the FCC's queries, we undertook an analysis of the cable system database by combining systems within various groupings. In particular, we looked at systems in markets of different sizes, systems with different subscriber counts, and systems owned by large multiple system operators.

In addition to providing the average of channel capacity and other relevant measures for each of the groups analyzed, we have also provided a weighted average (based on the relative value of each cable system's basic subscriber count in each group examined). In our view, this weighted average is an important measure to consider, as it provides the most revealing picture of the carrying capacity of the typical cable system.

Before examining the market-size breakout results, we first report the results for the nation as a whole. The weighted average[30] channel capacity is 59.5 channels for all cable systems for which data were provided on channel capacity. For these 7,453 systems, the weighted average of unused channels is 4.3.

Nationally, the unweighted average channel capacity, across all systems for which data are available, is 40.8, and for unused capacity is 9.4 channels. This lower value for the unweighted average indicates that many small cable systems (*i.e.*, those with fewer subscribers) have less channel capacity, a point we directly demonstrate below.

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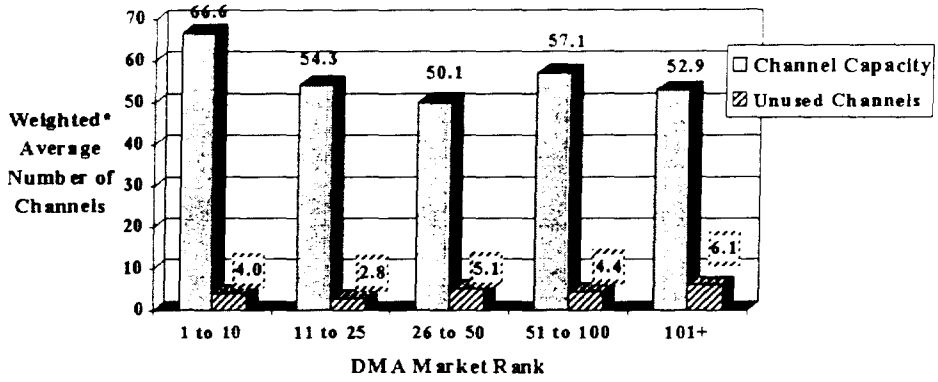
[30] Only those systems that had reported cable subscribers channel capacity and unused channels were included in these weighted-average calculations. To investigate if excluding those 2,153 systems reporting channel capacity but not reporting unused channel capacity biases the results, we compared the weighted average of that larger set with those reported and found little difference. The weighted average of channel capacity for the larger set was 58.6, very close to the weighted average of 59.5 for the systems reporting complete data.

1. Classification by Market Size

Figure 3 shows the weighted average of channel capacity and unused channels for cable systems in five different market size groupings. Generally, as one moves to smaller markets (*i.e.*, higher DMA ranks), the average channel capacity is lower, although the lowest average is for the mid-sized market groupings (DMAs ranked 26-50). As for unused channels, while there is no linear relationship between that value and market size, there do appear to be slightly more unused channels in the smaller markets. These data show that, in the largest television markets (where the Commission has required the earliest introduction of digital television service), the current capacity

Figure 3
Channel Capacity By DMA Rank



*Weighted by number of subscribers within each group

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cable systems to carry the new signals is the greatest.

Table 1 shows the unweighted averages of both channel capacity and unused channels for these five market size groupings. These channel-capacity averages are all lower than the weighted averages reported above because the larger systems have greater channel capacity in terms of the number of subscribers. Yet, the unweighted averages of unused channels are all higher, indicating that the smaller cable systems in these market size groupings tend to have more unused channels than the larger systems. Like the weighted averages, the unweighted averages for the smaller markets tend to have less channel capacity and more unused channels.

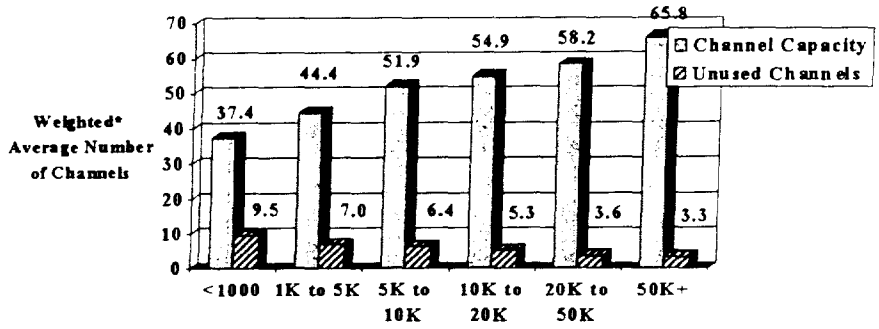
Table 1 Unweighted Average Channel Capacity and Unused Channels by DMA Rank			
	Unweighted Average		
DMA Rank	Channel Capacity	Unused Channels	Number of Systems
1-10	52.10	6.67	963
11-25	42.18	9.42	1,350
26-50	40.62	8.44	1,533
51-100	38.63	9.70	3,235
101+	37.41	10.10	3,636

2. Classification by System Size

That systems with fewer subscribers have smaller capacities and more unused channels is clearly borne out by the averages among different groupings of systems ranked by number of subscribers. Figure 4 shows the weighted averages for six groupings of system-subscriber levels. Table 2 shows the unweighted averages for these same six groupings.[31]

[31] Since the weights for the cable systems are based on relative subscriber counts, the weighted and unweighted averages are very similar for these groupings of cable systems by subscriber count.

Figure 4
Channel Capacity By System Subscribers



*Weighted by number of subscribers within each group

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Table 2
Unweighted Average Channel Capacity and Unused Channels by System Subscribers

	Unweighted Average		
System Subscribers	Channel Capacity	Unused Channels	Number of Systems
<1,000	35.58	11.35	4,567
1,000 - 5,000	43.28	7.30	1,696
5,000 - 10,000	51.06	6.43	484
10,000 - 20,000	54.23	5.30	354
20,000 - 50,000	57.42	3.70	301
50,000 +	65.70	2.51	196

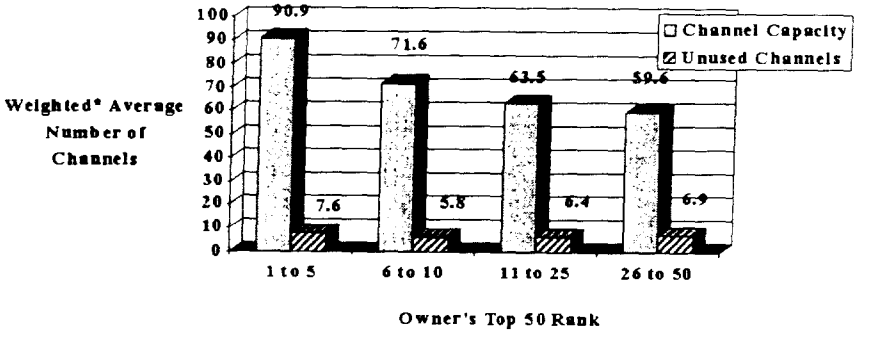
3. Classification by System Owner Size

Another question raised by the FCC is whether large multiple system operators (MSOs) tended to have larger capacity systems. The database provides information on whether a cable system owner is part of the Top 50 MSOs and its actual rank. The 4,733 systems owned by the Top 50 MSOs for which we have complete data tend to have much larger systems measured in terms of

channel capacity and more unused channels. The weighted average for this group is 81.7 channels for capacity and 7.0 unused channels.[32] The remaining 2,927 systems not owned by any of the top 50 MSOs (for which we have complete data) show a weighted average of 52.9 channels in capacity and 5.9 unused channels.[33]

Figure 5 and Table 3 show the weighted and unweighted average channel capacity by ownership Top-50-rank grouping. We note that the five largest MSOs account for 60 percent of cable subscribers. The weighted-average channel capacity decreases as one moves to the smaller MSOs; there is no readily apparent trend with respect to unused capacity.

Figure 5
Channel Capacity by MSO Top 50 Rank



*Weighted by number of subscribers within each group

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[32] The unweighted averages for this group are 42.5 channels for capacity and 8.1 channels unused.

[33] The unweighted averages for this group are 37.2 channels for capacity and 11.4 channels unused.

Table 3 Unweighted Average Channel Capacity and Unused Channels by Ownership Rank			
	Unweighted Average		
Ownership Rank	Channel Capacity	Unused Channels	Number of Systems
1-5	45.51	6.89	1,493
6-10	46.65	5.77	438
11-25	39.64	6.36	1,605
26-50	40.34	6.86	1,197

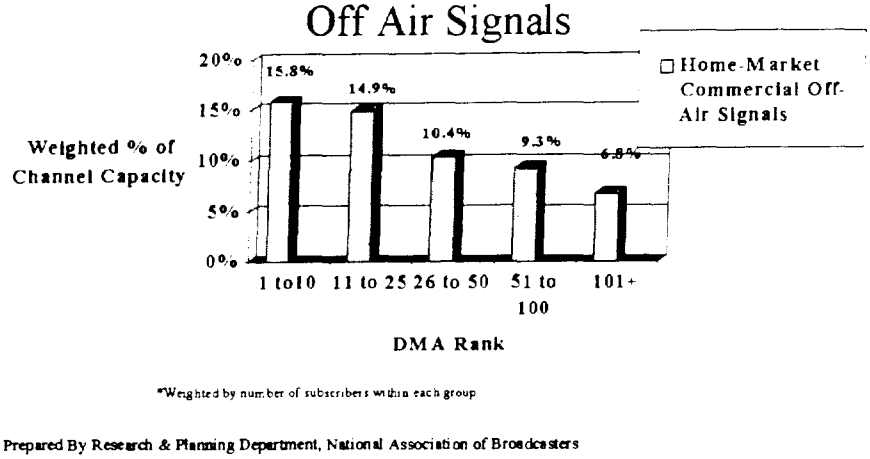
C. Off-Air Signals on Cable Systems

Given these channel capacities, we next examine what portion of cable systems are currently allocated to carriage of commercial off-air signals. While some of these signals are carried subject to the current must-carry rules, many, if not most, are carried voluntarily under retransmission consent agreements. Thus, the percentages represented overstate the "burden" of must-carry today.

Nationally, the weighted average percentage of cable-system channels occupied by home-market commercial off-air signals[34] is 12.2 percent. The unweighted national average is 11.1 percent. Figure 6 shows the weighted average for home-market commercial off-air signals for the five market-size groupings. Not surprisingly, as one moves to smaller markets, fewer of the cable systems' channels are allocated to home-market off-air signals since there are fewer over-the-air television stations in those markets.

[34] "Home-market commercial off-air signals" refer to those over-the-air full-power commercial television stations that are located in the same television market as the cable system.

Figure 6
Percentage of Channel Capacity
Allocated to Home-Market Commercial
Off Air Signals



*Weighted by number of subscribers within each group

Prepared By Research & Planning Department, National Association of Broadcasters

Table 4 shows the unweighted averages of cable capacity allocated to home-market commercial off-air signals for the five market-size groupings. Like the weighted averages, the unweighted averages for home market off-air signals decrease as one moves to smaller markets.

Table 4
Unweighted Average Percentage of Channel Capacity Allocated to Home-Market Commercial Off-Air Signals by DMA Rank

DMA Rank	Percentage
1-10	16.3%
11-25	13.4%
26-50	12.6%
51-100	11.1%
101+	8.4%

Our analysis of the current cable system capacity occupied by home-market commercial off-air signals produces several interesting observations. First, the average capacity currently occupied by such signals is today well below the 33 percent of capacity limit established by statute for must-carry. Second, even if the existing percentages doubled (as each station adds its DTV signal) and

cable capacity stayed the same, the total capacity occupied by home-market commercial off-air signals would be, on average, below the statutory ceiling. Third, cable systems in smaller markets (where there are also fewer broadcast stations) have relatively more unused capacity. This fact strengthens the case for an across-the-board must-carry rule applicable to all cable systems.

D. Synopsis

Our analysis of cable system channel capacity indicates that: (1) channel capacity has been expanding significantly over time; (2) existing channel capacity is quite substantial, particularly in large markets where the Commission has required digital television service to be rolled out first; (3) significant unutilized channel capacity currently exists; and (4) the capacity occupied by local broadcast stations (those eligible for must-carry) is well below the 33 percent statutory ceiling. These data provide *conservative* measures on a variety of counts (*viz.*, they are historical data, capacity is being expanded, technical advances are constantly increasing the carrying capacity of given bandwidth, *etc.*). They suggest that there are no *technical* constraints limiting the carriage of digital broadcast signals as the digital transition commences. Existing unused capacity in most cases could easily support carriage of new digital broadcast signals when the initial stations begin operation later this year.

VI. Cable Capacity in the New Digital World

A. Introduction

In this section of our report, we discuss the impact of current changes in video distribution technology on the major questions identified in the *Notice*, including the definition of cable capacity in the new digital world. Specifically, we review the impact of technological changes on the capacity of cable systems in the future, including the ability to increase the bandwidth of coaxial cable systems, the introduction of fiber optics into terrestrial video distribution systems, improvements in video encoding and compression technology, and the role of digital set-top boxes. We also discuss the implications of likely future uses of cable systems for non-TV telecommunications applications such as cable modems for Internet access, two-way interactive video, and voicegrade telephony. Our analysis shows that cable systems will be expanding capacity substantially over the course of the next five years during which time the transition to digital television is expected to take place.

B. Expansion of Cable Capacity for Video Distribution

Coaxial cable systems were first deployed in the 1960s to bring television programs to areas where broadcast signals were weak or nonexistent. The systems were technologically uncomplicated, consisting of a "head-end" where television signals were received over the air and a coaxial cable distribution system which retransmitted those signals past the homes of potential subscribers. Six MHZ of frequency spectrum was assigned for each over-the-air broadcast channel. These signals were remodulated and retransmitted, intact, over the coaxial cable systems. Since the signal became attenuated as it passed through the cable, amplifiers were installed at specified intervals to maintain the signal at appropriate levels. If a particular customer wanted to subscribe, the coaxial cable was "tapped" and a piece of cable installed to connect the main cable to the home.

Although the basic elements of coaxial cable systems have remained unchanged during the past 30 years, the use, extent, capacity and capability of cable systems have changed enormously. Coaxial cable systems are now deployed widely throughout the country, and provide many services in addition to those that originate over the air. Indeed the majority of television viewers in the United States today rely on cable as the primary means of obtaining television signals.

Among the most significant changes which have taken place in cable technology over the decades has been the continuous increase in the number of 6 MHZ television channels that can be carried on a coaxial cable (as discussed in the previous section). This is determined by the

bandwidth of the system, which in turn is a function principally of the capabilities of the amplifiers and the number of amplifiers in the series that must be traversed to reach the farthest customer.

As the bandwidth of the system increases, the spacing of the amplifiers must be decreased, since attenuation rates increase with increasing frequency. Furthermore, since whatever noise is introduced into the signal as it moves through the cable is amplified along with the signal, noise accumulates as the number of amplifiers increases. In order to prevent unacceptable deterioration of the signal, at some point, fiber optics can be introduced to replace the coaxial trunk plant, or backbone. Fiber optic systems usually do not employ amplifiers, and each remote node or coaxial cable section is served by one fiber. Fiber optic systems have virtually limitless bandwidth so, once in place, they can continue to support increases in capacity as the coaxial cable sections are upgraded. For this reason, they have proven to be an economical choice in many areas, and continue to be deployed at a rapid rate.[35]

The frequencies used in cable TV systems start at about 55 MHZ, which is Channel 2. Frequencies between 88 MHZ and 108 MHZ, which is the FM spectrum, and between 108 and 120 MHZ, which is allocated to aircraft communication and navigation, are usually not used because of the potential of interference with these services. Frequencies below 55 MHZ are reserved for potential traffic originating at the customer location and terminating at the head-end. Therefore, the effective analog capacity of the system is determined primarily by the upper bound of the amplifier capability. A 300 MHZ system can support about 36 channels, 400 MHZ about 52 channels, 550 MHZ about 77 channels, 750 MHZ about 110 channels and 1 GHz about 150 channels. Currently, there are a large number of 750 MHZ systems in place with a few at 1 GHz. Industry forecasts indicate that the number of these high capacity systems will substantially increase in the next few years.[36]

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[35] Cable companies accelerated their deployment of fiber optics in 1997 by 27 percent over 1996, totaling 134,370 route miles; cable operators are projected to deploy 23 percent more fiber in 1998, totaling 164,750 route miles. *See* National Cable Television Association Website at <http://www.ncta.com/overview98_1.html>, September 14, 1998.

[36] The National Cable Television Association (NCTA) claims that there will be $33 billion in infrastructure improvements during the years 1996-2001 and that 71 percent of cable homes would be passed by 550 MHZ-750 MHZ plant by yearend 1998. (*Ibid.*) NCTA has stated that "(c)able companies will invest (sic) over $12 billion over the past two years alone to upgrade their systems to provide customers with the best digital television." *See* Letter to Edward O. Fritts from Decker Austrom, President and CEO, NCTA (October 6, 1998). Time Warner recently announced that its $4 billion project to upgrade cable systems to a 750 MHZ, two-way plant had been accelerated and was on track for early completion in yearend 2000. (Testimony of Joseph J. Collins, Chairman and

(continued...)

The above discussion relates to the number of traditional 6 MHZ wide channels that can be carried on a cable TV system. As noted, this has been increasing steadily almost since the beginning of cable TV, and is expected to continue to increase for the foreseeable future.[37] An even more significant development, however, is the introduction of digital encoding and compression into the world of video transmission and distribution.

Digital encoding involves transforming the analog signal associated with a television signal into a stream of digital pulses, or bits — essentially a sequence of ones and zeros that completely represent the original signal. Digital encoding has many desirable properties. First of all, when a digital signal is sent down a transmission line such as a coaxial cable, it, too may need to be amplified periodically. However, the "amplifiers" in this situation merely regenerate the ones and zeros they receive so that, unless the signal is so badly deteriorated that the ones and zeros are unrecognizable, the signal leaving the amplifier is the same as the signal that entered the system. There is no accumulation of noise, which allows higher quality reception in most cases. Even in the event that there are errors in some bits, error-correcting codes are used to eliminate them.

For video distribution, these digital pulses are modulated into a radio frequency analog signal, and sent on the same 6 MHZ channels used for analog signals. Current coding methods allow up to 38 MB/s of digital information to be sent on a single 6 MHZ channel through a cable system. (Over-the-air broadcasts can transmit at only half that rate, because the signals are subject to interference from other signals, fading and multipath interference — obstacles that are in large measure not present within the closed environment of a cable TV system.)

Secondly, and perhaps more importantly from the standpoint of television distribution, the fact that the signal is now a series of binary digits allows the signal to be compressed to remove any

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36 (...continued)
CEO Time Warner Cable before the Senate Commerce Committee, July 8, 1998). TCI recently announced it was way ahead of schedule on upgrading its cable infrastructure that will give it two-way capability on more than 90 percent of its network by the end of the year 2000 and that between 92 and 95 percent of TCI's network will be able to handle two-way data and voice transmission. By yearend 2000, all TCI metropolitan areas are scheduled to have 750 MHZ plant and the suburbs at least 550 MHZ. (Grant Buckler, "AT&T & TCI Say Cable Upgrades Well Under Way," *Newsbytes*,June 29, 1998). Comcast estimated that, by yearend 1998, approximately 80 percent of its physical plant would be upgraded, with a majority of its cable systems providing 750-MHZ capacity. (Comcast Summary Annual Report 1997).

37 Paul Kagan Associates, Inc., has modeled cable channel capacity through the year 2004. Starting with a base of an average weighted 53 channels in 1996, Kagan predicted that channels would increase from 75 in 1998 to 140 in 2003 (interpolating the estimates for 2002 and 2004) — an increase of 65 channels. *See* Paul Kagan Associates, Inc., "Channel Logjam Eases — Capacity Projections to 2004," *Cable TV Programming*, July 31, 1996.

information which may be redundant or irrelevant. Successive frames of a television signal often contain much information that is unchanged. Digital signal processing can detect this, and transmit a very brief indicator that the item is unchanged, sharply reducing the number of bits required to convey the signal to the end user.[38] Several industry standards — denoted MPEG-1 and MPEG-2 — have been adopted for digital compression, with the result that many television signals can be carried in a single 6 MHZ analog channel.

The MPEG-1 standard will allow a single television signal to be compressed to as little as 1.5 MB/s while apparently retaining VHS videocassette quality. Full NTSC quality requires about 4 MB/s. Moreover, if a number of digital signals are sent over the same 6 MHZ channel, "statistical multiplexing" can be used. In this arrangement, the carrying capacity of the channel can be statistically shared between signals. Thus if, at a given point in time, one signal contains a lot of motion, which requires more bits, it can "steal" bits from a signal which is not currently experiencing any change between frames. This allows even more signals to be carried in a single 6 MHZ channel. The benefit of this approach has not been fully quantified, but one manufacturer has announced a system with 24 signals per channel,[39] and TCI's "Headend in the Sky" (HITS) system accommodates 18 digitized television signals in a single 6 MHZ channel.

MPEG-2 is used for the digital television (DTV) broadcast standard. It allows an HDTV signal to be compressed into about 19 MB/s of digital information, which, as discussed above, can be carried on a single 6 MHZ over-the-air channel or as half of the multiplex on a 6 MHZ cable channel (when digital modulation is used). The standardized 19 MB/s bit stream can also be used by broadcasters to provide a number of NTSC-quality programs or other signals.

Another aspect of the coming transformation of the industry is that, since digital technology relies heavily on technology commonly used in the computer and communications industries, most notably digital integrated circuit chips, costs can be expected to decline rapidly in the foreseeable future. "Moore's Law" formulated by Gordon Moore, a founder of Intel, states that the cost of semi-

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38 Using digital compression technology, operators are compressing as many as 12 digital channels into the space used by one analog channel, but are experimenting with compression schemes that exceed 20-to-1. (SG Cowen Securities Corporation, "Cable Television Industry Report", July 9, 1998, p.22. In 1997, TCI reported several important digital technical developments, including advancing its digital compression ratio to up to 12-to-1. (1997 TCI Annual Report). Industry analysts have anticipated that new digital services will use only small amounts of bandwidth, allowing capacity for future services. Salmon Smith Barney, "Entertainment/Media/Communications — Industry Report", J.S. Krutick, et. al, February 2, 1998.

39 *See* IMEDIA brochure: *IMEDIAStatMux, 24 Digital Channels in the Space of a Single Analog Channel.*

conductor devices drops by half every 18-24 months. This has been true for decades, and is expected to continue well into the next century

Taking all these factors into consideration, we see that the potential capacity of cable systems is likely to grow explosively within the next few years.[40]

Summarizing the above, the total system capacity of a cable TV distribution system is a function of:

- The total number of 6 MHZ channels (750 MHZ ≈ 110 channels);
- The number of channels converted to digital transmission;
- The transmission system used, which determines the digital data rate per 6 MHZ channel (current maximum of about 38 MB/s), and
- The compression method used and the signal quality desired (HDTV, SDTV, *etc.*), which determines the number of digital programs sent over a 6 MHZ channel (current maximum of 24, assuming 38 MB/s and extensive use of statistical multiplexing)

In a conservative example, if an 80-channel system devoted 4 channels to digital, ran the digital channels at 38 MB/s, and ran 18 multiplexed video signals per channel, then the total system capacity would be 76 plus 4 times 18, or 148 program services. In such a system, even if an additional 20 digital broadcast television channels needed to be carried, these would fit into ten 6 MHZ channels, or 6.8 percent of the system capacity.

If a cable operator in a smaller market had only 50 channels of capacity and did not operate a digital service, the broadcast digital signals would presumably be "passed through." Thus, if there were ten digital broadcast channels in the market, ten 6 MHZ channels, or 20 percent of system capacity, would be needed to carry them.

At the upper extreme limit (and no one has as yet proposed doing this), if a cable system with 110 6 MHZ channels operated its entire system digitally with even as few as 8 signals per channel,

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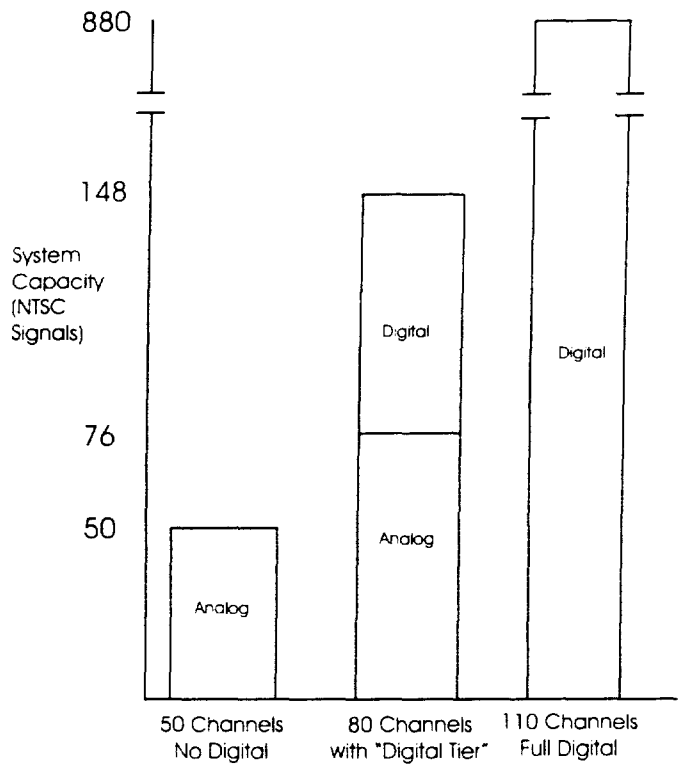
[40] Earlier this year, TCI expected to have between 800,000 and 1 million digital cable customers by yearend, and claimed to be rolling out digital as widely and quickly as possible. In March of this year, TCI was reportedly installing digital at the rate of 1,700 per day and expected to increase to 3,000 and 4,000 installations per day in the following month. ("More on TCI Digital" *Media Daily*, March 26, 1998). It is reported that most industry estimates say digital will replace advanced analog within seven to 10 years. As of May, TCI digital cable was reported to be available to more than 11 million of its 14 million subscribers, Time Warner was preparing to launch 79 channels of digital on top of 75-80 channels of analog, Cox intended to offer digital in all nine of its major cluster markets, which encompass roughly 85 percent of its total subscriber base. (*Broadcasting & Cable*, "Special Report '98" May 4, 1998). According to the Cox Communications/New England web page, Cox's rebuild will result in "100's of new cable channels." *See* http://www.cox.win/newengland/genifo/ge02001.htm.

it would yield a system capacity of 880 video signals. Again, 20 digital broadcast video signals using ten 6 MHZ channels would effectively displace 80 of the 880 channels, or 9 percent.

The range of potential system capacity is illustrated by the scenarios in Figure 7.

With all these possibilities, and with widely varying rates of capacity expansion among operators, it is extremely difficult to predict a precise measure of system capacity at any particular point in time during the next five years. On the one hand, a case could be made for assuming that

Figure 7
Cable System Scenarios



the maximum attainable capacity will be achieved, since all operators have the potential for reaching the maximum. On the other hand, since many operators will not, in fact, exploit the full potential, it can be argued that some other assumption should be used. It seems, however, that some number between the current deployment and the maximum possible is reasonable to assume. Certainly, given the technological opportunities discussed above, and the potential additional service opportunities discussed below, a number between 200 and 500 mixed digital and analog channels is readily within the reach of most operators within the next few years, and is a reasonable number to use to estimate the "burden" of full digital TV must-carry.

C. Set-top Boxes

Not only must digital signals be properly processed at the head-end (although the HITS system does that for the operators) but, more importantly, they require digital set-top boxes in every home that receives the digital signals. The current strategy of the cable operators is to roll out digital signals in a "digital tier" which is sold as a premium service, modulating the roll-out of the service and the installation of set-top boxes as the demand for the digital tier evolves.

Set-top boxes have been a staple of the cable TV industry since its beginning. In the analog world, basic set-top boxes are fairly simple devices, which take the analog signal from the cable and remodulate it so that it can be accepted by the television set. Over time, the functionality has increased somewhat, to include signal scrambling in order to prevent unauthorized viewing, and to contain screen menus. Increasingly, many of these functions have been included in "cable-ready" television sets.

The digital world is more complex. Digital set-top boxes accept digital signals, and transform them into analog signals before presenting them to an ordinary analog television set. There is currently no effective industry standard for the functionality of such devices, although standardization efforts are continuing.[41]

It is clearly desirable for cable TV operators to utilize a box which could process its own digital tier, and also a DTV signal from a broadcaster. If cable TV operators are required to carry DTV signals, it is most likely that those who also operate a "digital tier" will specify a set-top box that can process both kinds of signals. This will not add much to the cost of the box, but will allow the cable TV operator to carry two broadcast DTV signals in a single 6 MHZ channel. The alternative is to pass the broadcast signal directly through to the digital TV set, requiring a full 6 MHZ channel to carry a single DTV signal.

Thus, a requirement that cable TV operators carry broadcast DTV signals is likely to spur the effort to reach an industry standard for digital set-top boxes, which in turn would lead to the development of standard, lower cost (because of standard design and increased volume) boxes that

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[41] The National Cable Television Association reports that cable operators continue to develop open technical standards that will accelerate cable's provision of new digital services. In September 1997, CableLabs and its members established "OpenCable," a project aimed at obtaining a new generation of set-top boxes that are interoperable. These new devices will enable a new range of interactive services to be provided to cable customers. Since that time, CableLabs has been establishing consensus within the industry on the appropriate standards, interfaces and features which will allow for this desired interoperability. *See* National Cable Television Association Website at .http://www.ncta.com/overview98_1.html>. September 14, 1998.

can process a variety of signals which can be fed to both digital and analog television sets.[42] The availability of such units may even provide incentives for cable TV operators to introduce a digital tier if they have not already done so, thus providing their customers with more program choices.

D. Expansion of Cable System Capacity for Telecommunications Applications

As we move into the next century, it becomes increasingly likely that the coaxial cable systems that currently pass nearly all households will be used for a wide variety of telecommunications services. The potential to provide these services is one of the most exciting opportunities faced by the cable television industry. It is this potential that, we believe, will drive the rapid expansion of cable system capacity such that the imposition of full digital television must-carry can be expected to have only minimal impact.

There has been much speculation about the use of cable television systems for telecommunications services for many years, but implementation, until this year, has rarely gone beyond trials. There have been a number of reasons, regulatory, technical, operational and financial, for the failure of this market to develop.

To begin with, up until recently, many local jurisdictions would not allow competition in local telecommunications service, which is where the cable television assets would be most useful.

Secondly, there are substantial technical and operational problems involved in conditioning the cable plant to support telecommunications services. Among these are:

- **One-way versus two-way operation.** Cable system amplifiers usually operate in only one direction. Carrying telecommunication signals, which are always two-way, requires modification of all cable amplifiers.
- **Service continuity in the event of power failure.** Cable systems are typically powered from commercial sources, on the grounds that if power is out there is no need for service

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[42] The TCI Group and other cable operators have placed an order for 15 million advanced digital set-top devices in 1997. (1997 TCI Annual Report.) TCI also has reported plans to embed a cable modem in every digital set-top box it sells in the future. (Grant Buckler, "AT&T & TCI Say Cable Upgrades Well Under Way," *Newsbytes*, June 29, 1998.) Time Warner has announced order of one and a half million advanced digital *Pegasus* set-top boxes, which will allow viewers to receive digital television, including DTV. Time Warner planned to start field-testing of *Pegasus* during 1999. (Testimony of Joseph J. Collins, Chairman and CEO Time Warner Cable before the Senate Commerce Committee, July 8, 1998.) AT&T officials have said that subsidy deals with outside vendors cut the cost of digital set-tops to about $175 from more than $300. (*Television Digest*, "AT&T Plans $4.4-Billion Upgrade," July 6, 1998.)

since the television sets are also inoperable. Telephone systems, however, are powered from the telephone central office, which has various emergency backup systems.

- **System architecture.** Cable systems are normally configured as a "tree" with all signals emanating from the headend and going to all users. Telephone systems are configured as "stars" with each pairwise connection individually established.
- **Billing systems.** Cable systems typically bill on a monthly basis for services provided. Telephone systems are more transaction oriented, keeping track of a myriad of individual calls.

Finally, the financial structure of the cable industry, characterized by heavy debt loads, did not readily lend itself to the substantial capital investments in cable retrofits and switching system acquisitions necessary to enter these markets.

A number of forces are now coming together which promise to overcome these difficulties. The first of these is the passage of the Telecommunications Act of 1996. This landmark legislation established the clear intent to spur competition in local telecommunications markets through the elimination of remaining barriers to entry. Secondly, the explosion of Internet usage, and the increasing demand for higher bandwidth access provides an unprecedented opportunity for cable systems. Cable begins with a decided competitive advantage over the telephone companies since cable has a broadband medium in place. Thirdly, the consolidation of the industry, typified by the pending acquisition of TCI by AT&T will bring both needed capital and telecommunications skills into the cable industry, setting the stage for rapid expansion into telecommunications markets.

The prospect of entering these markets will provide additional incentives for cable operators to continue to expand their systems, both by increasing analog capacity, and by adding digital capabilities, which can clear capacity for telecommunications applications without compromising their basic cable TV business (including the carriage of digital television signals).

To be specific, the telecommunications applications of cable TV are of three basic types — Internet access, or cable modems; voicegrade telecommunications; and two-way video services, including video telephony and video conferencing. We address each of these separately:

1. Internet Access

The virtual explosion of Internet usage during the past few years has led to an accelerating demand for higher data rate access as people try to download video clips, pictures, and ever larger files. The idea of using the coaxial cables that carry TV signals past so many houses for Internet

access has seemed quite evident, since the bandwidth of these cables is so much larger than that of the typical telephone lines. Hence the development of "cable modems," which are currently being deployed in many areas, and for which very rapid growth in the next few years appears almost certain.[43]

Cable modems generally operate at rates of between 4 and 30 MB/s "downstream" from the Internet Service Provider (ISP) to the user, and at a lesser rate "upstream,"[44] compared with a maximum of about 56 KB/s for current modems that operate on telephone lines. This increase of at least several orders of magnitude represents a significant improvement, making some Internet applications feasible that were previously too slow. One of the difficulties in exploiting this demand is that, as mentioned above, cable TV systems are designed for one-way operation. Internet access requires two-way operation, even though the data rates are not equal in both directions. Hence, cable amplifiers, which are the one-way elements in the cable TV systems, need to be replaced — a similar exercise to what is required to increase system capacity. If the cable system has not been modified for two-way transmission, the upstream signal may be sent by telephone, although this is not a particularly desirable arrangement since it requires two separate connections, which may lead to coordination problems.

Since cable modems operate using packet switching protocols, much like local area networks, the total bandwidth that they occupy will depend on the usage patterns of the customers. Therefore, instead of attempting to estimate the amount of capacity that will be used, we will describe how the network can be continually modified to accommodate the data needs of the cable modems.

If the cable system can carry signals in both directions, the low data rate "upstream" signals will be carried at frequencies below the broadcast band which are currently not used. These signals will have no effect on system capacity. The constraint is "downstream," where the high-speed data flows will occur.

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[43] The National Cable Television Association reports that, in March 1997, CableLabs (the cable industry's research and development consortium) and its members announced the finalized radio frequency (RF) segment of the Data Over Cable Service Interface Specification (DOCSIS), which will allow CableLabs to certify that modems/set-tops meet the standards for interoperability and could lead to lower cost modems in 1998. Currently, CableLabs and its members have established a formal path of certification for cable modem equipment suppliers to obtain and "interoperability seal" for their high-speed data delivery devices based on the MCNS/DOCSIS specification. A certification board has been established that will assure that cable operators are buying modems that meet the new universal compliance standards. *See* National Cable Television Association Website at ,http://www.ncta.com/overview98_1.html>, September 14, 1998.

[44] *See* "Cable Data Modems," published by CableLabs, April 1996.

These "downstream" signals can be carried within a 6 MHZ channel at various data rates, depending upon the modulation system being used. The systems must be traffic-engineered to be sure that there is adequate capacity for the traffic loads being offered by the users. If a single 6 MHZ channel becomes inadequate, then additional channels can be used, if desired. Alternatively, the cable operators may decide to reduce the number of homes passed by a coaxial cable section, therefore reducing the data traffic load, by increasing the deployment of fiber optic lines.

A typical cable system will ordinarily use a large optical fiber cable "trunk" to feed a large number of coaxial cable "nodes." These nodes can vary substantially in the number of homes they reach, from as few as 500 to as many as 2,000. Each such node may in turn connect to a different fiber in the fiber optic cable, so there is effective reuse of the coaxial cable capacity. Therefore, if a cable operator finds a heavy cable modem load in a particular area, it can expand its fiber optic line, breaking a large node into several smaller ones and reusing the channels.

Cable operators, then, can treat cable modems as an opportunity, expanding their systems to meet this expected demand as well as other needs, or, if more economical, installing more fiber to limit the number of customers on a coaxial cable.

This is a market that is not speculative. It is real. Furthermore, unlike cable TV, it is not a monopoly. Telephone companies are rapidly deploying ADSL technology in their plant, which is an alternative means of providing high-speed Internet access. (This technology is only marginally suitable for video distribution, since it typically can handle only a single video channel, and often with less than full broadcast quality.) Cable modem penetration is small, so far, but many operators have offered the service[45] and still more have announced that they are preparing for it by upgrading

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[45] According to the National Cable Television Association, cable companies have expanded commercial cable modem services into approximately 87 markets throughout the U.S, and 13.9 million cable homes have access to residential cable modem services in 29 states, and 125,000 cable customers subscribe to the services. Cable operators are creating new on-line services, including @Home, Road Runner, Optimum Online, MediaOne Express, Bresnan Link, PowerLink and Charter Pipeline. *See* National Cable Television Association Website at ,http://www.ncta.com/overview98_1.html>, September 14, 1998. Cox has announced availability of *@Home* service to residences in Orange County, San Diego, Phoenix, Omaha, New England, Hampton Roads and Oklahoma City. (Testimony of James O. Robbins, CEO Cox Communications before the Senate Commerce Committee (July 28, 1998). Cox's Internet service had over 15,000 customers by yearend 1997 and 18,000 customers by mid-February 1998. (1997 Cox Communications Annual Report). In 1997, Cablevision began offering *Optimum Online* technology to link customers to the World Wide Web to homes in Connecticut and New York. (Cablevision 1997 Annual Report). Comcast reported expanded availability of *Comcast@Home* high-speed cable modem Internet access service. Comcast's high-speed Internet access was available to 1.1 million homes and had 16,000 subscribers as of March 1998. (1997 Comcast Annual Report). It predicted that availability would more than double by yearend 1998. (Comcast Summary Annual Report 1997). Time Warner has ordered one and a half million *Pegasus* advanced digital two-way set-top boxes that will provide high-speed Internet access. (1997 Time

(continued...)

their cables to two-way operation and increasing capacity.[46] As cable operators increase system capacity, they can easily accommodate the demands of digital television must-carry.

2. Voicegrade Services

Voicegrade services, typified by telephony, are a potentially large market in terms of customers and revenues. They have a much smaller bandwidth requirement than Internet access. The current technology of choice is to "channelize" the individual lines, dedicating a portion of the total bitstream to each equivalent line. At 64 KB/s, a 38MB/s channel can carry over 500 conversations (one way). Since voice conversations need two-way service, two channels are required for 500 conversations, but only one need be in the critical downstream portion of the spectrum. It is likely that, within the next few years, packet technology will be used for this application as well, in the same manner as cable modems currently operate. At that time, even more equivalent telephone lines can be accommodated within a single 6 MHZ channel. It is not clear at this time how much of this market the cable industry will attract, but it is potentially a large revenue generator for which the industry will need to provide whatever is required.[47] Where cable systems expand capacity to offer

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[45] (...continued)
Warner Annual Report and Testimony of Joseph J. Collins before the Senate Commerce Committee, July 8, 1998). TCI's high-speed Internet data service is currently being marketed to 500,000 homes in San Francisco, Hartford, Chicago, Dallas and Seattle, with additional market launches planned for 1998. (1997 TCI Annual Report and Testimony of Leo J. Hindery before the Senate Commerce Committee, July 28, 1998.)

[46] The National Cable Television Association cites industry estimates that, by year-end 1998, 44.8 million homes (47 percent) will be passed by two-way plant. *See* National Cable Television Association Website at ,http://www.ncta.com/overview98_1.html>, September 14, 1998. TCI predicted the merger with AT&T will yield an integrated package of services over a highly sophisticated broadband network platform using a broadband infrastructure will consist of two-way capable systems upgraded to 550 MHZ and 750 MHZ . It also predicted TCI cable headends would utilize Internet-Protocol technology, which will allow offering of video, voice and data services in electronic "packets" over the same wire. (Testimony of Leo J. Hindery before the Senate Commerce Committee, July 28, 1998.)

[47] During 1997, the cable industry reached interconnection agreements in 37 states and the District of Columbia. *See* National Cable Television Association Website at http://www.ncta.com/overview98_1.html>, September 14, 1998. TCI has announced that the merged AT&T and TCI entity will compete aggressively in the local telephone market. (Testimony of Leo J. Hindery before the Senate Commerce Committee, July 28, 1998). AT&T announced it would spend an average cost of $400 per customer to provide IP telephony in TCI markets. ("AT&T outlines TCI upgrade costs, telephony strategy" Broadcasting & Cable, July 6, 1998, p.37). Cox announced launch of Cox Digital Telephone in Orange County, California and Omaha, Nebraska, and expansion within those markets and into other Cox cities. Cox also announced it was beginning to provide phone service packaged with high-speed Internet access services to residents of large apartment complexes. (Cox Communications Inc. Summary Annual Report 1997). In 1997, Cablevision reported that its *Cablevision Lightpath* served more than 1,000 high-end business customers and moved quickly into Connecticut and throughout the New York region. Cablevision's *Optimum Telephone* residential phone services was launched in several Long Island
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voice telephony, the incremental cost of adding capacity for digital television must-carry will be minimal.

3. Video Telephony

Finally, we consider video telephony. This is a market that has barely been invented. There are a few videoconferencing services currently on the market, but there is no commercially viable video telephone service currently in place, or even announced. Nevertheless, it is certainly possible that, as video compression systems get cheaper (and they, too, will undoubtedly follow Moore's Law) video telephony will become a real market. Even if only 10 percent of current telephone users buy it, it becomes an important business opportunity. The transmission characteristics are similar to cable modems, except that two-way transmission at the same rate must be accommodated. Currently, 1.5 MB/s using the MPEG-1 encoding algorithm provides VCR-like picture quality, which is more than adequate for such a service. In fact, there are commercially successful videoconferencing systems currently on the market which operate at 384 KB/s, and some as low as 128 KB/s. However, the lower the bit rate, the poorer the picture quality and the more complex and expensive the compression system.

The serving arrangements the cable operators will need to deploy are the same as for cable modems; increased capacity, two-way operation and fiber optic deployment, all of which reinforce current trends.

It is not yet clear how all this will shake out. It is possible, however, that in less than a decade, many of these services will begin to take off. If the cable industry is to fully exploit these opportunities, it will need to have ample capacity in place to meet the needs. Unlike cable TV distribution, these services are competitive. The incumbent telephone companies, wireless carriers and satellite operators will be eager and competent to meet these demands if they materialize, so we can anticipate that the cable industry will position itself accordingly — in part by continuing to roll out increased capacity, both digital and analog, at a rapid rate for the foreseeable future.

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[47] (...continued)
communities. (Cablevision 1997 Annual Report).

E. Synopsis

A careful analysis of the trends in cable system technology suggests that cable operators will be expanding both analog and digital capacity at an unprecedented rate in order to deploy their own digital television services and to win the race with telcos and others for the high-speed Internet access business. The cable industry can also be expected to add capacity in order to offer voice telephony and to position itself for video telephone services. This capacity expansion should easily accommodate full digital television must-carry and the resulting "burden," would be less in relative terms, than the "burden" created by the existing must-carry rules. Moreover, if the FCC promptly mandates digital television must-carry (as it should), given the cable industry's already-announced plans to upgrade their systems, cable operators will incur little incremental cost in making certain that adequate capacity is available when needed. What is critical is that the Commission act now so both cable operators and broadcasters can plan efficiently for the transition.

VII. Conclusions and Recommendations

A must-carry obligation for digital broadcast television signals is a critical component of the transition to a universally available digital television service. Congress anticipated the important role that digital TV must-carry would play and has clearly mandated (as the Jenner & Block analysis shows) the FCC to modify its cable carriage rules to meet the statutory objectives.

In implementing Congressional intent, the Commission should mandate, during the transition period, that each new 19 MB/s digital signal be carried without modification of content and without degradation. Our analysis demonstrates that, much as was the case with the existing must-carry rules, cable systems, on average, have adequate capacity to carry these signals as they begin to be transmitted later this year without jeopardizing carriage of existing cable program services. This is particularly true since the number of digital television stations will be relatively small in the early years and concentrated in the large market, where capacity is typically greater.

Looking ahead, our examination of cable's already announced plans for expanding system capacity to provide their own digital services, Internet access and voicegrade services (as well as the potential for video telephony) demonstrates that cable systems will be adding substantial capacity in any event. As cable system capacity expands (and especially with the use of modulation methods which will enable cable operators to carry two 19 MB/s digital broadcast signals in one 6 MHZ cable channel), there should be more than enough room to accommodate additional digital TV signals as more stations begin DTV operations. A clear mandate from the FCC now for full digital TV must-carry will, therefore, permit operators to provide for the additional capacity at virtually no incremental cost.

In sum, then, given the opportunities for technological enhancement and for expansion of service offerings facing cable operators, capacity in the range of 200 to 500 channels (analog and digital) is easily within the reach of most cable systems over the next few years. Viewed in that context, requiring full digital TV must-carry during the transition would actually impose less of a burden on the average cable system in relative terms than the existing must-carry requirement. Contrary to the claims of some cable programmers, a full must-carry requirement will not threaten carriage of existing cable services or foreclose the addition of new cable in the future.

Certificate of Service

I, Kimberly Washington, hereby certify that I have, this 29th day of October 1998, caused to be sent by mail, first class postage prepaid, copies of the foregoing "Comments of the National Association of Broadcasters" to the following"

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